SEMANTIC WEB & KNOWLEDGE GRAPH

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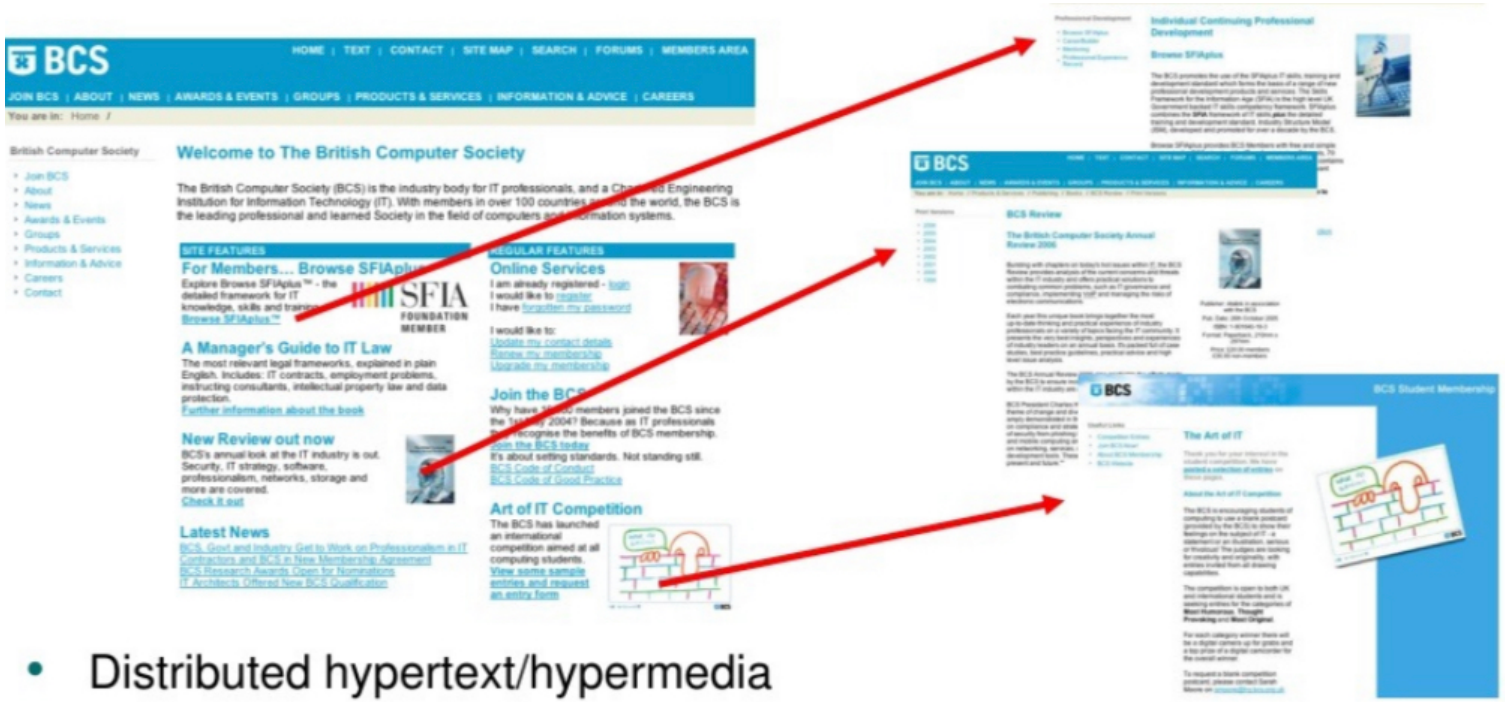
OUTLINE

- Semantic Web
- Three phases of Semantic Web
- Knowledge Graphs

SEMANTIC WEB

TODAY'S WEB



- Distributed hypertext/hypermedia
- Information accessed via (keyword based) search and browse
- Browser tools render information for **human consumption**

SYNTACTIC VS SEMANTIC

- Syntactic
  - how we communicate things
- Semantic
  - how we understand things

WHAT IS SEMANTIC WEB?

- enhancement of the current World Wide Web with machine-understand-able information
- together with services utilizing this information
- Provision of machine understandable information in this case is done by endowing data with expressive metadata for the data.
- in the Semantic Web, this metadata is generally in the form of ontologies
- establishing efficient methods and tools for data sharing, discovery, integration, and reuse

METADATA

- The origins of the Semantic Web lie in metadata
- Metadata is data about data
  - A webpage is data
  - A description of the webpage is metadata
  - Metadata for a webpage could include
    - author
    - date of publication
    - file size
    - …
- Library cataloguing = metadata

SEMANTIC WEB VS WORLD WIDE WEB

- The World Wide Web is the Web for people
  - Information is predominantly textual
  - Technologies include URI, HTTP, XML, HTML

- The Semantic Web is the Web for machines
  - Information needs to be structured
  - Technologies include RDF, RDFS, OWL
    (in addition to those for the Web)

THREE PHASES IN SEMANTIC WEB

THREE PHASES OF SEMANTIC WEB

Ontologies

Linked Data

Knowledge Graphs

PHASE 1: ONTOLOGIES

- Ontology is a knowledge base of concepts and their relationships specified in a knowledge representation language based on a formal logic
- In Semantic Web, ontologies are the main vehicle for data integration, sharing, and discovery
- Standard to build ontologies:
  - OWL
  - RDF
  - SPARQL

WEB ONTOLOGY LANGUAGE (OWL)

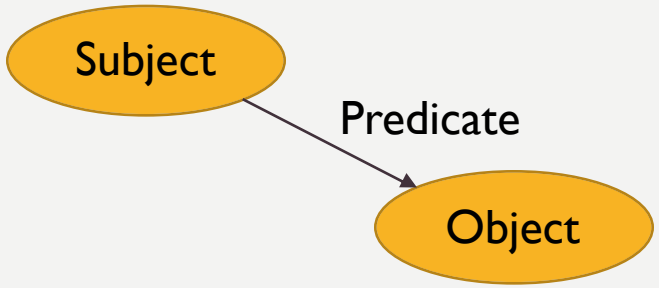
- OWL is a computational logic-based language
- Knowledge expressed in OWL can be exploited by computer programs
- Based on description logic

RESOURCE DESCRIPTION FRAMEWORK (RDF)

- RDF is a syntax for expressing directed, labeled, and typed graphs
- OWL ontology can serve as a schema for RDF typed graphs
  - Use OWL to specify an ontology of types and their relationships
  - Use the types as types in RDF graphs
  - Represent relationships as edges

COMPONENTS OF RDF

- In RDF graphs, all data are declared in the form of
  - Subject —> Predictae —> Object



CONTOH RDF

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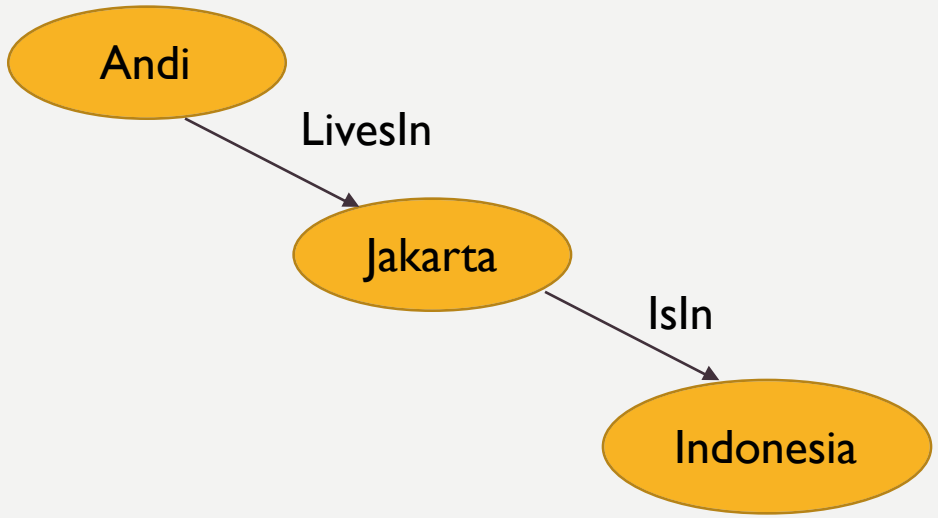

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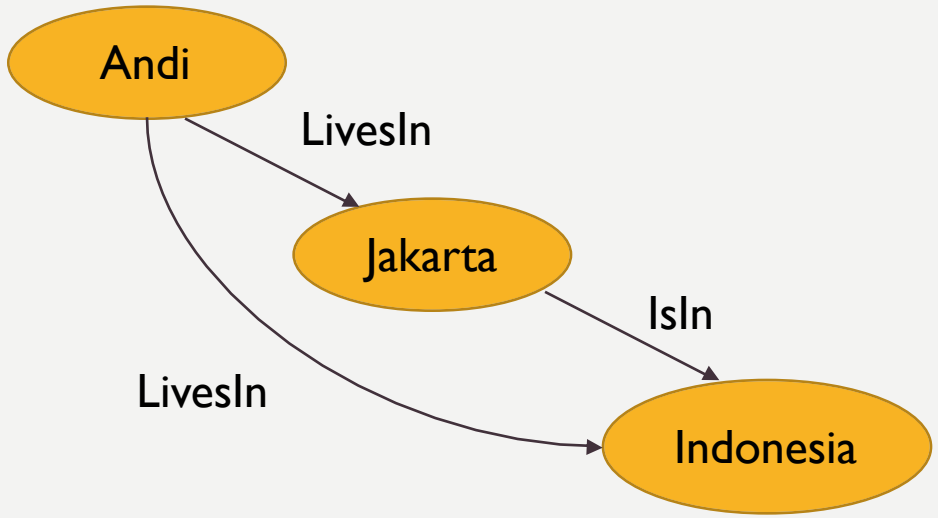


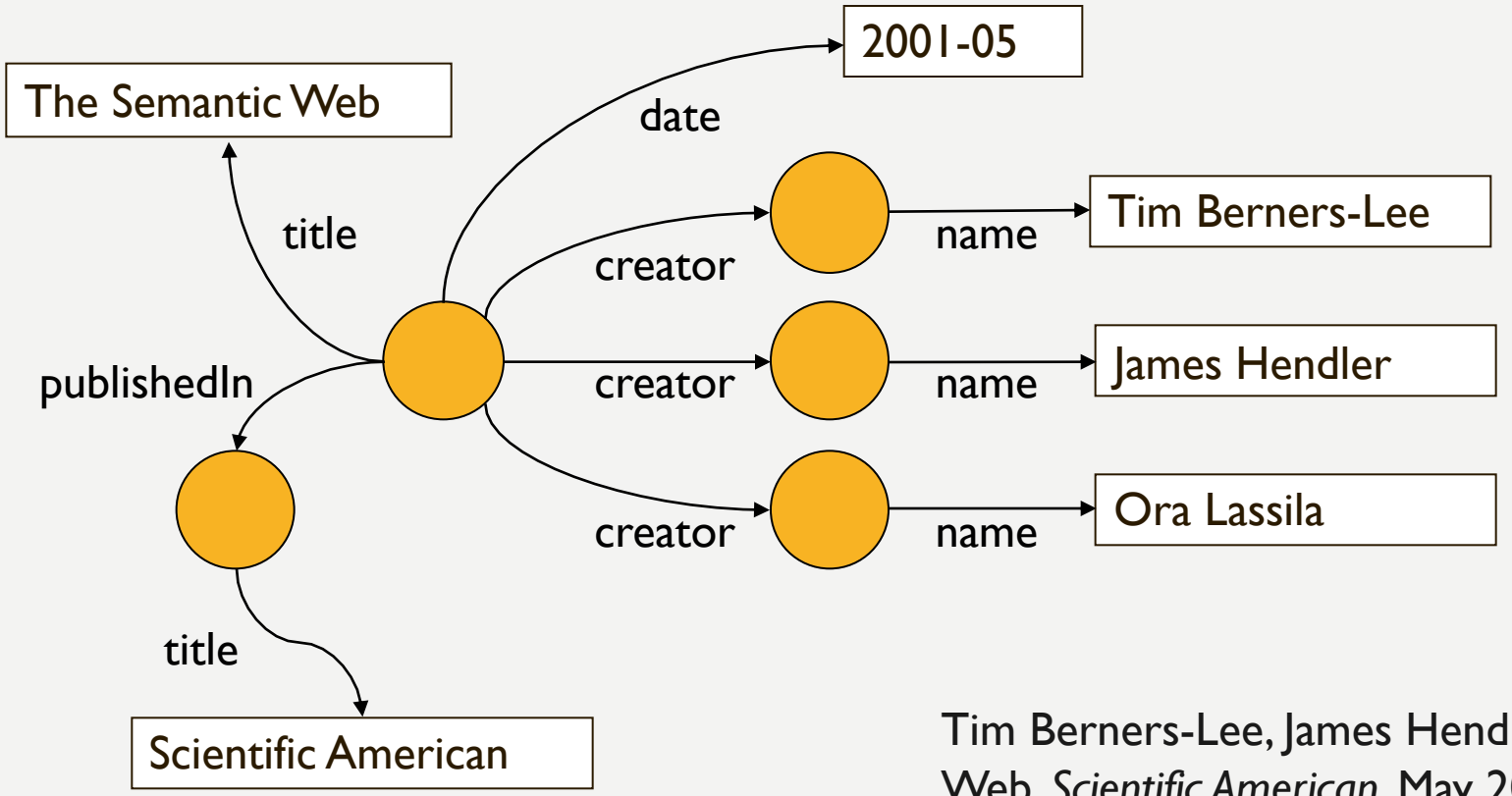
MORE EXAMPLE

- Take a citation:

  Tim Berners-Lee, James Hendler and Ora Lassila. The Semantic Web. *Scientific American*, May 2001

- We can identify a number of distinct statements in this citation:
  - There is an article titled "The Semantic Web"
  - One of its authors is a person named "Tim Berners-Lee" (etc)
  - It appeared in a publication titled "Scientific American"
  - It was published in May 2001

- We can represent these statements graphically



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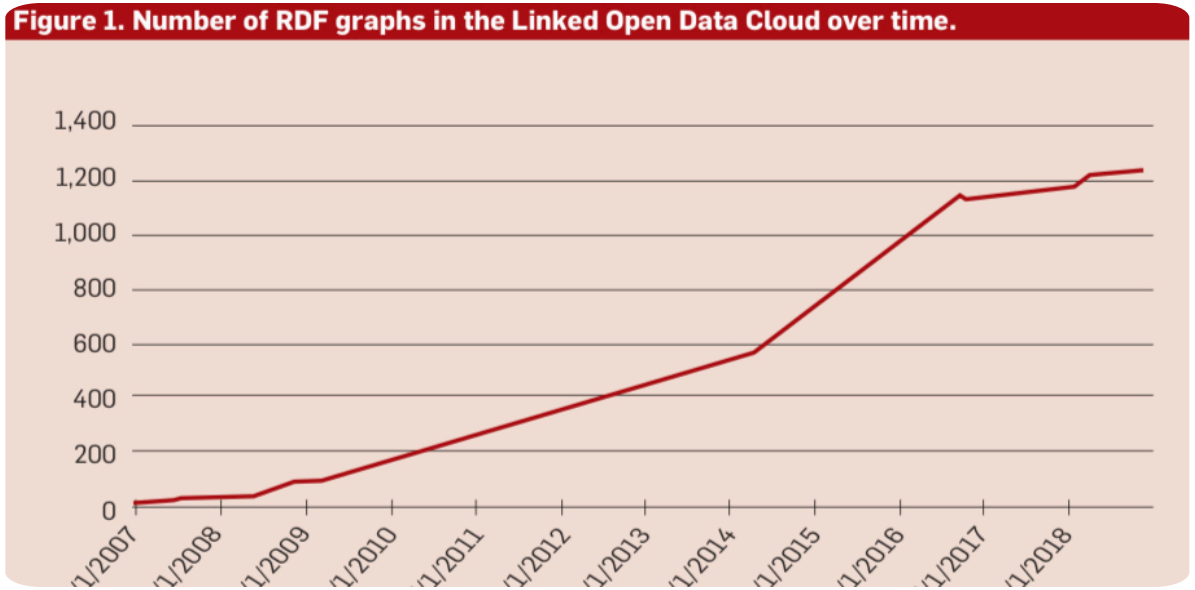
SPARQL

- SPARQL is an RDF query language
- Semantic query language for database that is able to retrieve and manipulate data stored in RDF format

PHASE 2: LINKED DATA (1)

- Consists of set of RDF graphs that are linked
- The collection of all linked RDF graphs can be understood as one very big RDF graph
- The number of publicity available linked RDF graphs has been showing significant growth



PHASE 2: LINKED DATA (2)

- In this phase, ontologies played a much less prominent role
- The information in RDF graphs was shallow
- It turned out that we need much effort in integrating data

PHASE 3: KNOWLEDGE GRAPHS

- Knowledge graph is a knowledge base that uses a graph-structured data model to integrate data
- Often used to store interlinked descriptions of entities while also encoding the semantics underlying the used terminologies
- Focus on connection between concepts and entities to represent semantics

(MORE ABOUT) KNOWLEDGE GRAPHS

KNOWLEDGE MODEL

- Knowledge model is a collection of interlinked descriptions of concepts, entities, relationships and events where:
  - Descriptions have formal semantics that allow both people and computers to process them in an efficient and unambiguous manner;
  - Descriptions contribute to one another, forming a network, where each entity represents part of the description of the entities related to it;
  - Diverse data is connected and described by semantic metadata according to the knowledge model.

COMPONENTS OF KNOWLEDGE GRAPHS

- **Database**
  - the data can be explored via structured queries
- **Graph**
  - they can be analyzed as any other network data structure
- **Knowledge base**
  - they bear formal semantics, which can be used to interpret the data and infer new facts.

THANK YOU